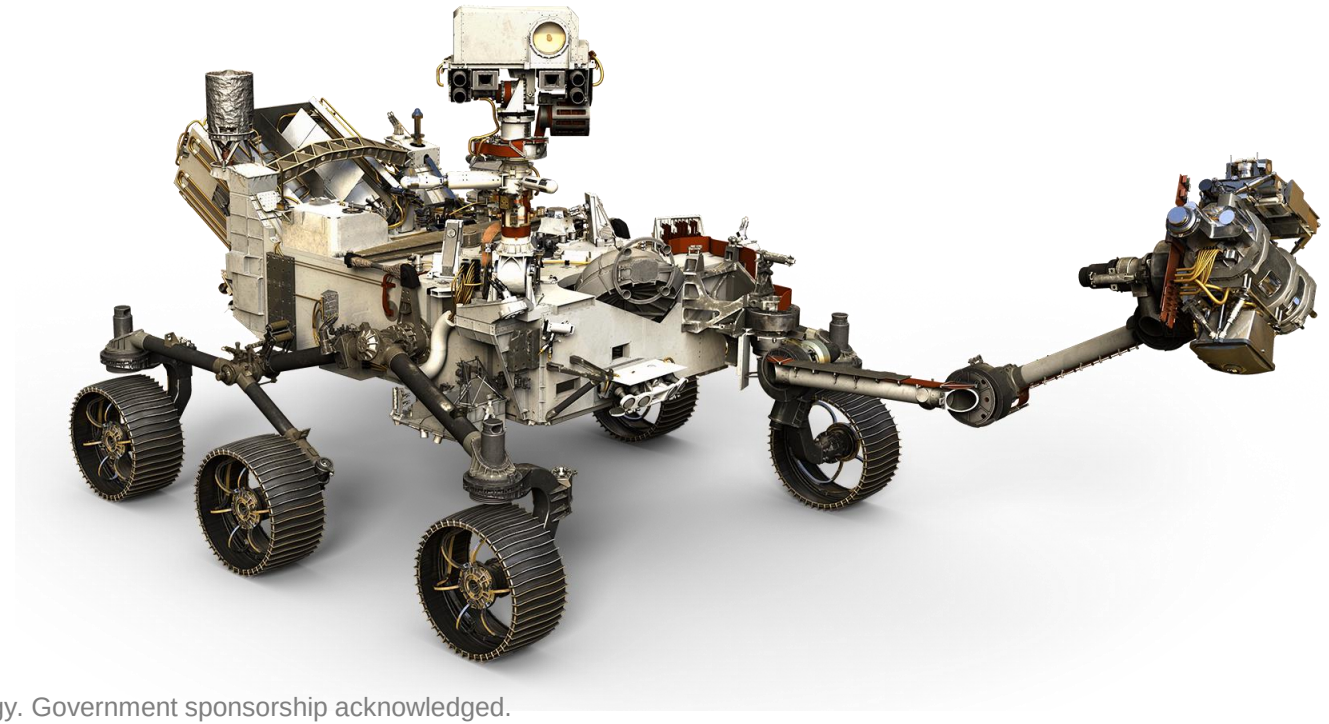
Jet Propulsion Laboratory
California Institute of Technology

Leveraging Heritage on the Mars 2020 Project

Matt Wallace, et al.

Mars 2020 Deputy Project Manager

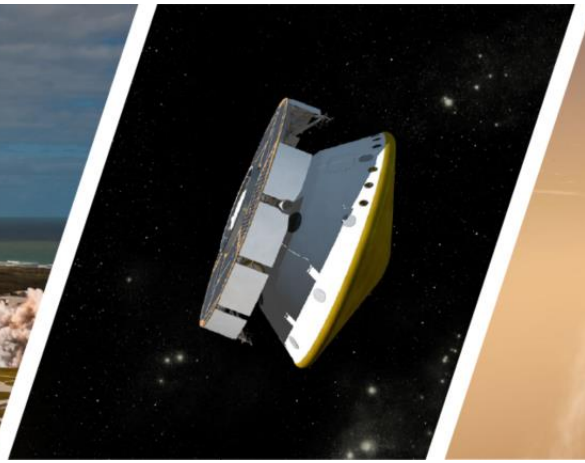


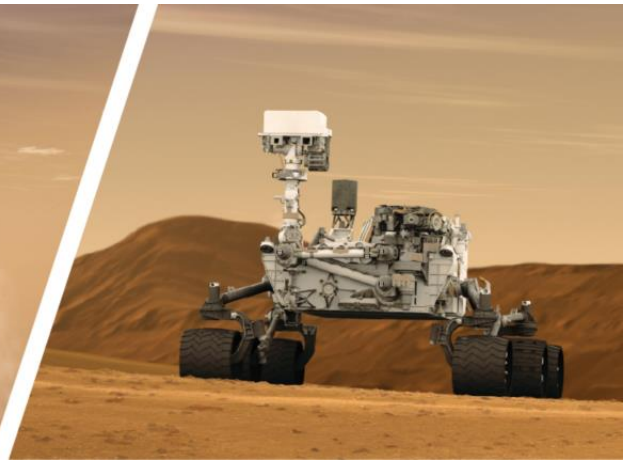
March 9, 2017

© 2016 California Institute of Technology. Government sponsorship acknowledged.

Mission Overview

Jet Propulsion Laboratory
California Institute of Technology



LAUNCH

- Atlas V 541 vehicle
- Launch Readiness Date: July 2020
- Launch window: July/August 2020

CRUISE/APPROACH

- ~7 month cruise
- Arrive Feb 2021

ENTRY, DESCENT & LANDING

- MSL EDL system (+ Range Trigger and Terrain Relative Navigation): guided entry and powered descent/Sky Crane
- 16 x 14 km landing ellipse (range trigger baselined)
- Access to landing sites ±30° latitude, ≤ -0.5 km elevation
- Curiosity-class Rover

SURFACE MISSION

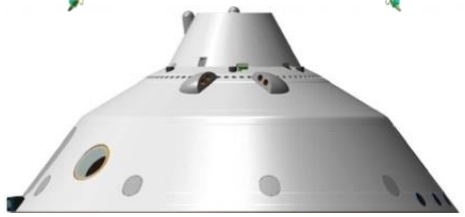
- 20 km traverse distance capability
- Enhanced surface productivity
- Qualified to 1.5 Martian year lifetime
- Seeking signs of past life
- Returnable cache of samples
- Prepare for human exploration of Mars

Spacecraft Build Approach

Jet Propulsion Laboratory
California Institute of Technology

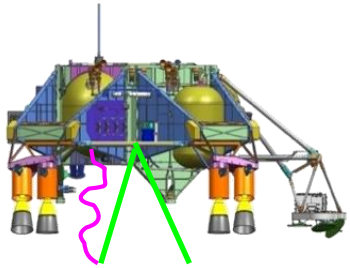
Launch Vehicle
- KSC/Launch Services Program procurement

- Built in-house at JPL
- Lowest cost and risk per make-buy study and industry RFIs



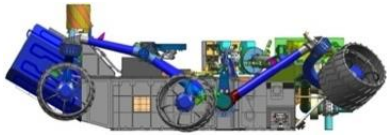
- Built by Lockheed-Martin/Denver
- Procure as sole source—most cost effective

MMRTG
- DoE procurement to industry



- Built in-house at JPL
- Major industry subcontracts/components
- Rebuild in-house due to criticality of EDL and rover interface

Science & Exploration Technology Investigations
- Source per proposals via AO selection

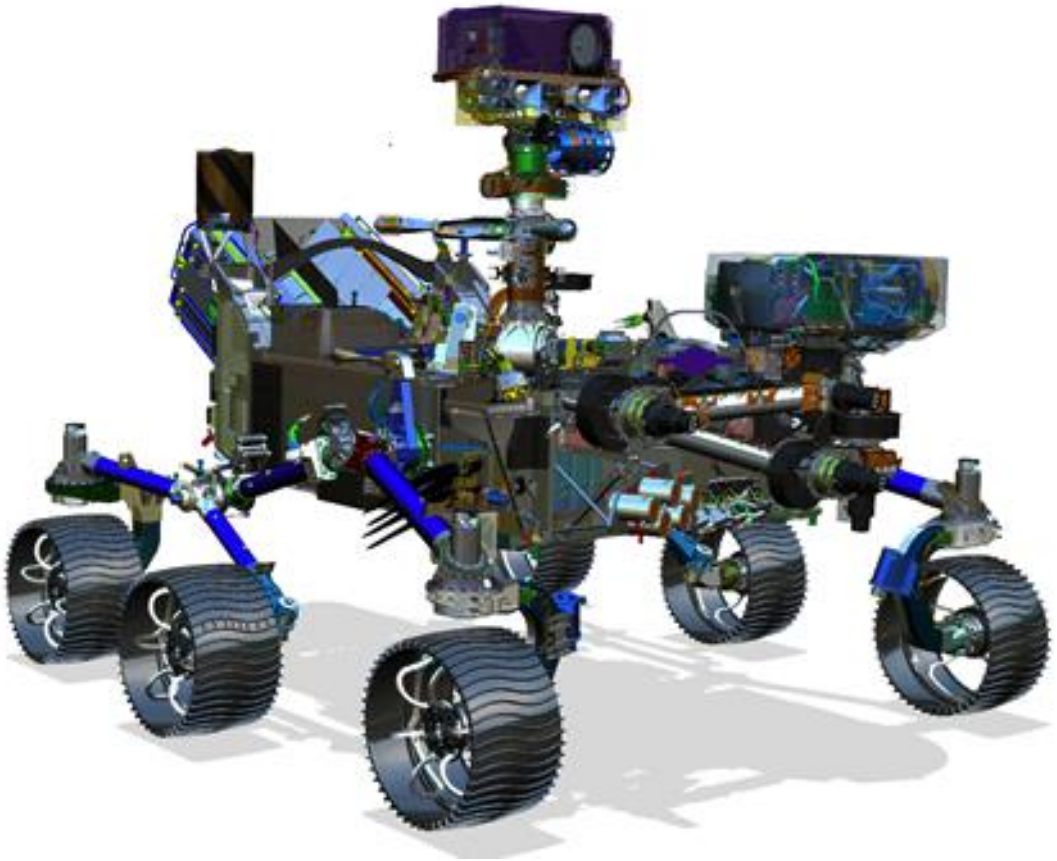


- Built in-house at JPL
- Major industry subcontracts/components
- Spanish contributed High Gain Antenna
- Rebuild in-house due to complexity of vehicle, residual hardware, criticality of EDL and rover interface, operations experience

MEDLI2
- NASA Centers (LaRC, ARC, and JPL)

- Built by Lockheed-Martin/Denver
- Procure as sole source—most cost effective

Mars 2020 Rover Concept



High Heritage from MSL

- Avionics
- Power
- GN&C
- Telecom
- Thermal
- Mobility

Changed

- New Science Instrument Suite
- New Sampling Caching System
- Modified Chassis
- Modified Rover Harness
- Modified Surface FSW
- Modified Rover Motor Controller
- Modified Wheels

Mars 2020 Heritage Policy

Jet Propulsion Laboratory
California Institute of Technology

The Mars 2020 Project Heritage Policy identifies the following objectives:

1. Preserve the successful flight heritage of mission critical system elements from MSL thereby reducing mission risk.

2. Reduce projected implementation cost and schedule by avoiding non-recurring design development.

3. Reduce cost and schedule risk / uncertainty by eliminating a vast majority of design driven problems.

Mars 2020 Heritage Policy

The policy document is guided by a set of strategic observations and principles:

- Mars 2020 will require a level of heritage reuse that is fundamentally unmatched in previous flagship JPL missions. The project is breaking new ground.
- The Project will baseline MSL system designs wherever feasible as a starting point. Modifications will be managed by a codified change control process.
- The Project must quickly recognize and realistically plan for modifications where the MSL approach is not feasible, or at risk. Heritage should not be assumed viable in the face of real threats.
- The Project should accept that the designs and systems were properly analyzed and evaluated on MSL as a starting point, but review all artifacts (waivers, problem reports, test results, analyses, etc…) for residual, altered, or unknown risks

Mars 2020 Heritage Policy

The policy document is guided by a set of strategic observations and principles: (continued)

- Successful utilization of heritage requires recognition of and maximum adherence to heritage in many domains beyond just the design itself, including the build processes, organization and facilities, key personnel, GSE and V&V programs, environmental requirements, etc...
- Often heritage assumptions breakdown when heritage elements are inserted into systems with new interfaces. For this reason, the project shall endeavor to maximize heritage upward to the highest level of assembly, including preservation of full subsystem designs and entire vehicles wherever possible.
- The Project should extend the applicability of the heritage policies to vendors to the maximum extent possible, understanding that these elements were just as critical as in-house builds.

Mars 2020 Heritage Policy

Jet Propulsion Laboratory
California Institute of Technology

Key Areas of Focus:

- Change Control
- Reviews
- Acquisitions
- Documentation
- Verification and Validation

Design Response

Area	MSL Flight System Component	Heritage Status
CRUISE STAGE		
Power	Cruise Power Assembly	Heritage
Power	Cruise Power Analog Module A/B	Heritage
Power	Cruise Solar Array	Heritage
GNC	Sun Sensor Electronic & Heads A/B	Heritage
GNC	Star Scanner-A/B	Heritage
Mechanical	Cruise Stage Structure / LVA	Heritage
Mechanical	Cruise Stage Harness	Heritage
Propulsion	Cruise Stage Propulsion	Modified - New thruster vendor
Thermal	Cruise Thermal Design / Thermal Hardware	Heritage
Telecom	Cruise Antenna's	Heritage
AEROSHELL		
Mechanical	Backshell	Heritage
Mechanical	Heatshield	Heritage
Payload	MEDLI-2	Modified
Mechanical	Parachute	Heritage
Mechanical	BIP, PSS, PCC	Heritage
Telecom	Parachute UHF Antenna & Closeout Cone	Heritage
DESCENT STAGE		
Power	Descent Power Assembly	Heritage
Power	Descent Power Analog Module A/B	Heritage
Motor Control	Descent Motor Control Assembly	Heritage
Power	Power Thermal Batteries (2)	Heritage
Power	Pyro Thermal Batteries (2)	Heritage
GNC	Descent IMU-A	Heritage
GNC	Descent IMU-B	Heritage
Telecom	Descent Stage X-Band - TWTA	Heritage
Telecom	Descent Stage X-Band (SDST)	Heritage
Telecom	DS Antennas	Heritage
Radar	Radar / Terminal Descent Sensor	Heritage
Thermal	Descent Stage Design / Thermal Hardware	Heritage
Mechanical	Bridle Umbilical Device	Heritage
Mechanical	Descent Stage Structure	Heritage
Mechanical	Descent Stage Harness	Heritage
Propulsion	Descent Stage Propulsion	Heritage

Area	MSL Flight System Component	Heritage Status
ROVER		
Avionics	Rover Compute Element A/B	Heritage
Power	Rover Power Assembly / Shunt Radiators	Heritage
Power	Rover Power Analog Module-A/B	Heritage
Motor Control	Rover Motor Control Assembly	Modified
Power	Rover Pyro Firing Assembly	Heritage
Power	Rover Battery	Heritage
Power	Rover MMRTG	Heritage
Mechanical	Rover Chassis	Modified
Mechanical	Rover Harness	Modified
Avionics	Surface FSW	Modified
Avionics	EDL FSW	Heritage
Mechanical	Mobility	Modified
Thermal	Rover HRS	Modified
Telecom	RVR X-band - SSPA	Heritage
Telecom	RVR X-band (SDST)	Heritage
Telecom	Rover Low Gain and UHF Antennas	Heritage
Telecom	High Gain Antenna System	Heritage
Telecom	UHF Radio -A/B (Electra)	Heritage
GNC	RIMU-A/B (LN200)	Heritage
GNC	TRN VCE & Camera	New
Imaging	NavCams (4)	New
Imaging	HazCams (8)	New
Mechanical	Remote Sensing Mast	Modified
Sampling	Adaptive Caching System	New
Sampling	Robotic Arm Assembly	New
Sampling	Coring Drill	New
Payload	EDL Cameras	New
Payload	SHERLOC	New
Payload	PIXL	New
Payload	MOXIE	New
Payload	MEDA	New
Payload	RIMFAX	New
Payload	MastCam-Z	Modified
Payload	SuperCam	Modified

Results to Date

Jet Propulsion Laboratory
California Institute of Technology

Project has recently completed it's Critical Design Review

Cost and schedule performance have been extremely stable